

An Early and In-Situ Cell Failure Detection and Reconditioning System for Lithium-Ion Batteries, Phase I

Completed Technology Project (2018 - 2019)



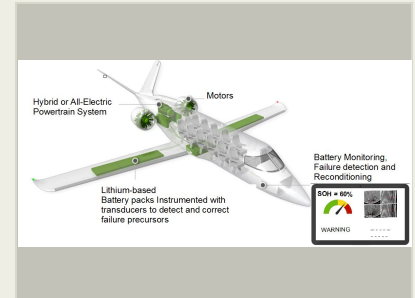
Project Introduction

There is substantial evidence suggesting that a Lithium-ion cell undergoes internal structural and mechanical changes prior to a catastrophic failure. Some of these changes include electrode expansion, electrode ruffling, dendrite formation, internal gas formation, and internal density changes. A key characteristic of these changes is that most of them occur prior to any external measurable parameter variation, such as in terminal voltage, surface temperature, or mechanical surface strain. Therefore, detecting internal cell structural and mechanical changes early and with adequate resolution has several benefits, including the prevention of catastrophic accidents sufficiently ahead of time, and the gathering of additional information that can be used to more accurately assess the health and life of cells during operation. We propose a novel approach that simultaneously detects and corrects these internal cell changes early and using hardware that can be permanently installed externally on the surface of a lithium-ion cell. Our approach enhances the safety and prognostics associated with lithium-ion batteries, and its reconstruction capability has the added benefit of rejuvenating a cell to extend its life. Finally, the proposed solution will be implemented on small, low cost, and low power hardware to ensure its seamless integration to existing commercial cells and systems.

Anticipated Benefits

It is estimated that the proposed system can have a substantial impact in the following NASA projects: Advanced Air Transport Technology (AATT) project, Flight Demonstrations and Capabilities (FDC) project, Transformation Tools and Technologies (TTT) project, as well as the NASA X-57 prototype and other efforts where electric and/or hybrid-electric propulsion systems are being engineered at NASA.

Battery technologies are critical for renewable systems, such as solar, wind, and hybrid/electric vehicles. Batteries are also a critical component in large data centers and in aerospace systems where failures must be detected early, accurately, reliably, and cost effectively. Our customers should include US government agencies, such as DOD, NASA, DOE, and commercial companies such as Boeing, GE, Tesla, GM, Ford, among others.



An Early and In-Situ Cell Failure Detection and Reconditioning System for Lithium-Ion Batteries, Phase I

Table of Contents

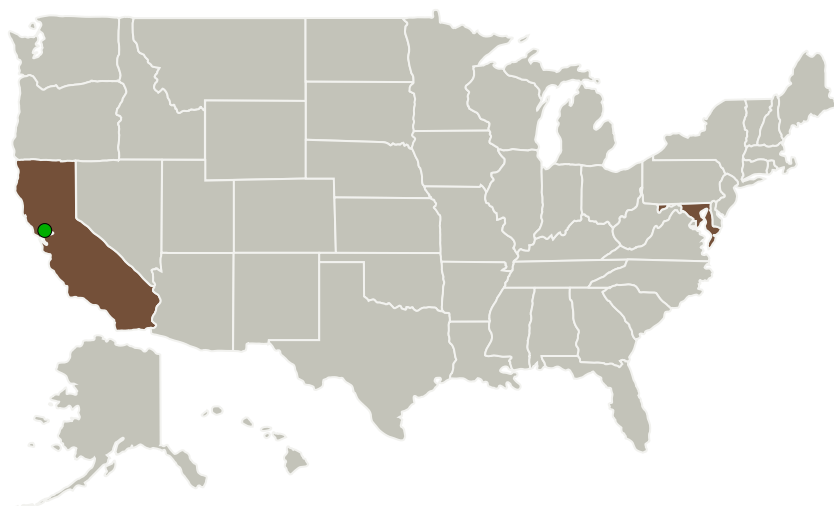
Project Introduction	1
Anticipated Benefits	1
Primary U.S. Work Locations and Key Partners	2
Project Transitions	2
Organizational Responsibility	2
Project Management	2
Images	3
Technology Maturity (TRL)	3
Technology Areas	3
Target Destination	3

An Early and In-Situ Cell Failure Detection and Reconditioning System for Lithium-Ion Batteries, Phase I

Completed Technology Project (2018 - 2019)



Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
X-wave Innovations	Lead Organization	Industry Women-Owned Small Business (WOSB)	Gaithersburg, Maryland
● Ames Research Center(ARC)	Supporting Organization	NASA Center	Moffett Field, California

Primary U.S. Work Locations

California	Maryland
------------	----------

Project Transitions

**July 2018:** Project Start

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

X-wave Innovations

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

Carlos Rentel

Co-Investigator:

Carlos Rentel

An Early and In-Situ Cell Failure Detection and Reconditioning System for Lithium-Ion Batteries, Phase I

Completed Technology Project (2018 - 2019)

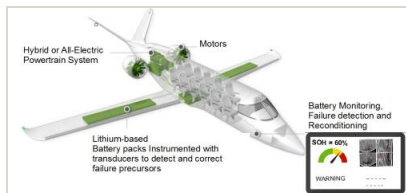


February 2019: Closed out

Closeout Documentation:

- Final Summary Chart(<https://techport.nasa.gov/file/140927>)

Images



Briefing Chart Image

An Early and In-Situ Cell Failure Detection and Reconditioning System for Lithium-Ion Batteries, Phase I

(<https://techport.nasa.gov/image/130729>)



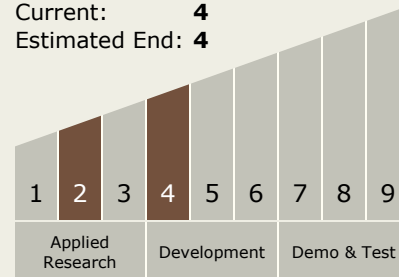
Final Summary Chart Image

An Early and In-Situ Cell Failure Detection and Reconditioning System for Lithium-Ion Batteries, Phase I

(<https://techport.nasa.gov/image/128556>)

Technology Maturity (TRL)

Start: 2
Current: 4
Estimated End: 4



Technology Areas

Primary:

- TX01 Propulsion Systems
 - TX01.3 Aero Propulsion
 - TX01.3.8 All Electric Propulsion

Target Destination

Earth